

A detailed illustration of a military operation. In the upper left, a white surveillance or command aircraft with a large radar dome is shown. In the upper right, a military helicopter is in flight. The central and lower portions of the image depict soldiers in camouflage uniforms engaged in various activities on a battlefield. The entire scene is overlaid with a faint, light-colored grid pattern.

Addressing the challenge of Air-to-Ground communications

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Taking Command and Control Data to the Tactical Edge

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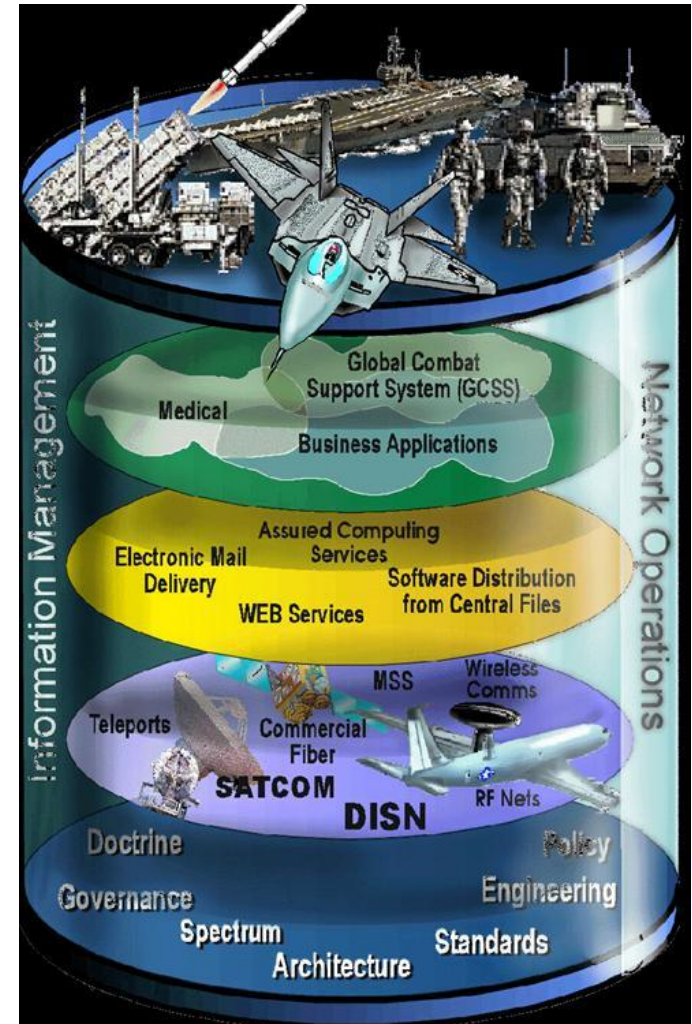
Effective warfare requires...

- **Seamless communications between combat elements**
- **Addressing the challenge of low-bandwidth restrictions at the tactical edge**
- **Timely Situation Awareness**
- **Ability to pass data across disparate systems without significant information loss**



DOD's Complex Enterprise Communications

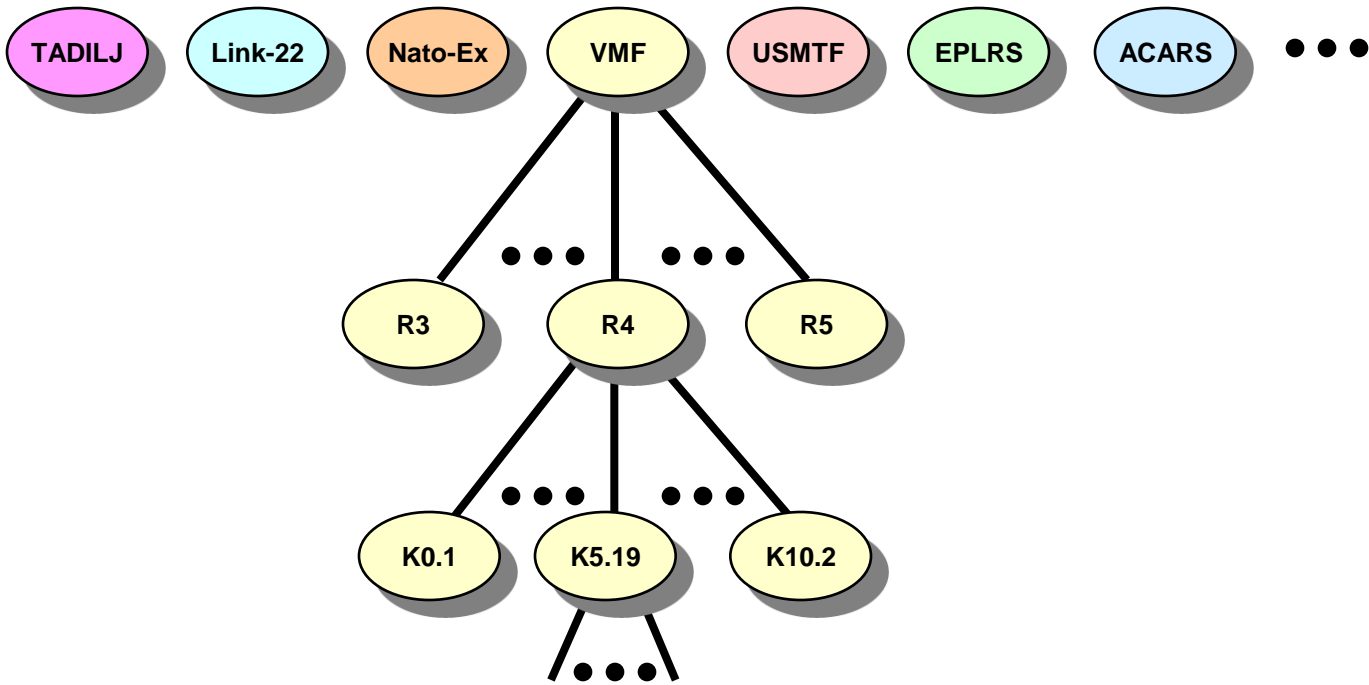
- **Multiple message formats**
 - *Link-16*
 - *VMF*
 - *GCCS*
 - *Etc.*
- **Radio transmissions can be on the order of 2400 bps**
 - *Communications at the tactical edge cannot handle the data being passed on the GIG*
- **Multiple versions of equipment do not communicate with each other**
 - *F-16 Block 50/52 and F-16 Block 60*
 - *VMF support for Digital CAS complicated by multiple versions*



Taking Command and Control Data to the Tactical Edge



Complexity Example: VMF K05.19 in Context



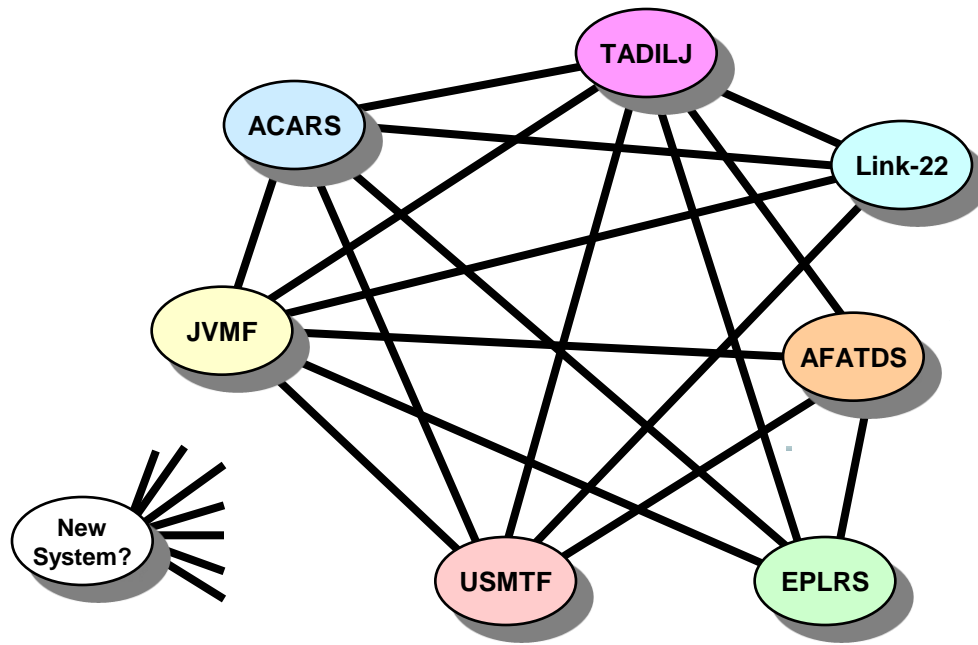
18,014,398,509,482,000 variations

The “total” complexity is simply overwhelming!

Taking Command and Control Data to the Tactical Edge



...Worse Yet, We're Building Numerous Complex Translators



This is a long-term interoperability and maintenance nightmare...

(E.g., How many systems must change to implement MIL-STD-6016D?)

(E.g., How many systems implement “the full” standard?)

(E.g., How do you “synchronize” rollout of standards versions?)

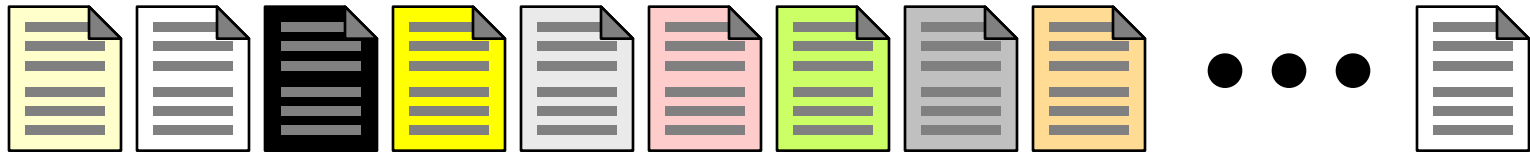
(E.g., Will I need to carry *another* radio to talk to a new link?)



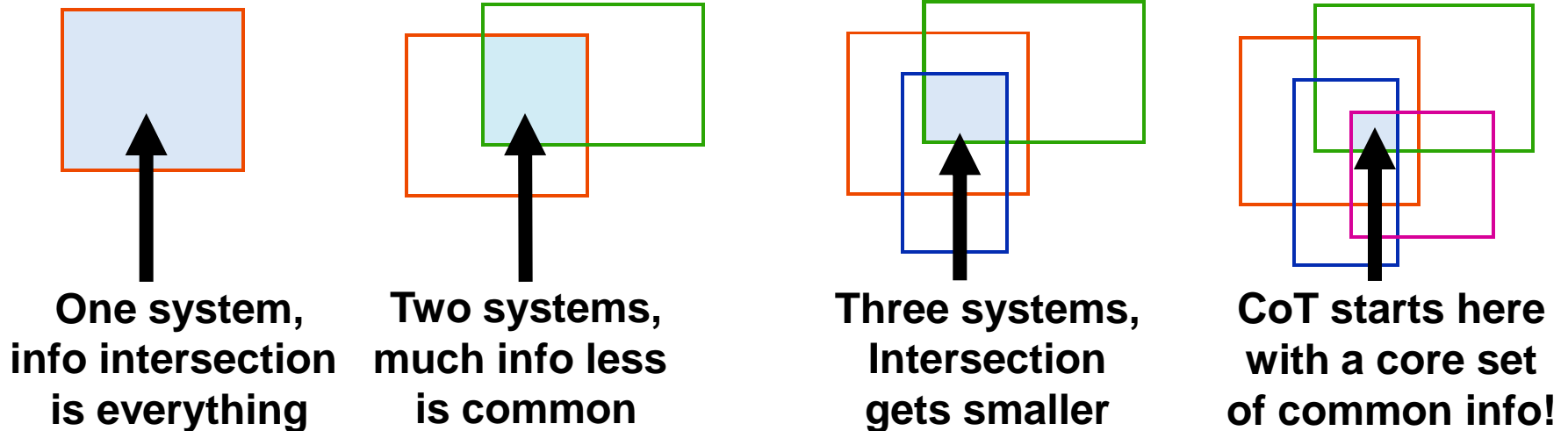
**Cursor on Target resolves
many of these issues...**



CoT Takes a Different Approach: Start with the most common info



Traditional approach: Add a new message for each new exchange...
and the “catalog” gets large.



What is the core?

“What, Where, Whe

Surveillance results:

What: ISR data

Where: 73°—74°...

When: 1930Z—...

Details: www.intel.af//...

Direct Fire Mission:

What: Engage Hostile

Where: 72.558°...

When: 1950Z—...

Details: www.biggun.army//...

Blue Force Tracking:

What: Friendly

Where: 72.31234°...

When: 1930Z—...

Details: www.4thBgd//...

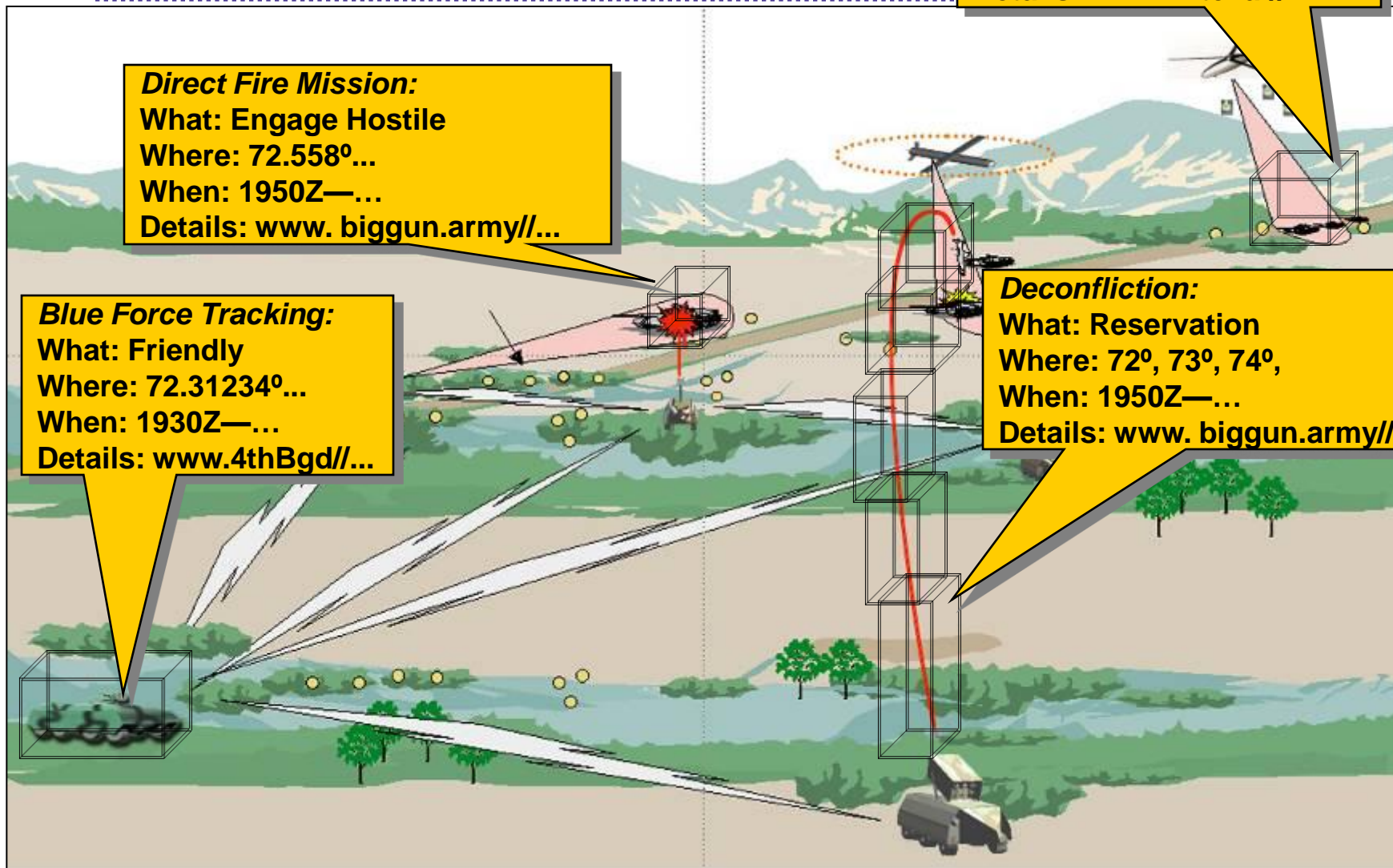
Deconfliction:

What: Reservation

Where: 72°, 73°, 74°,

When: 1950Z—...

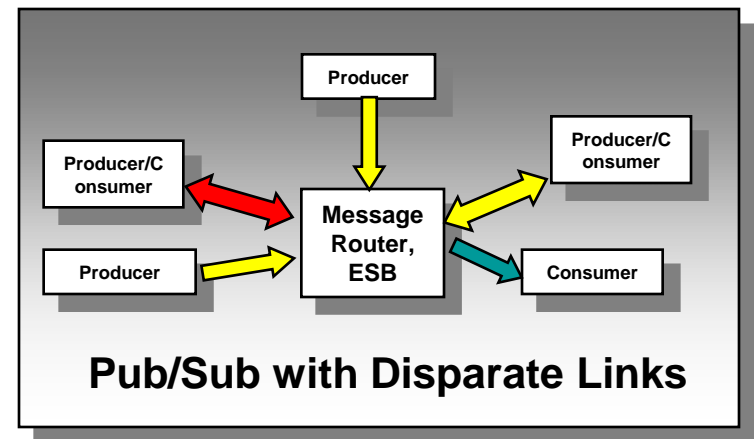
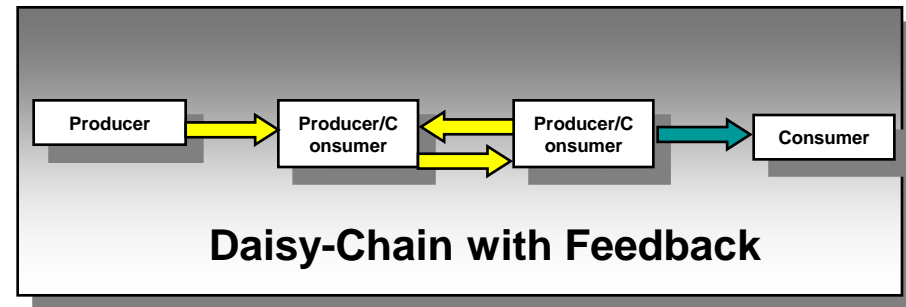
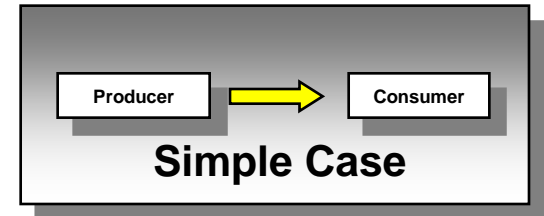
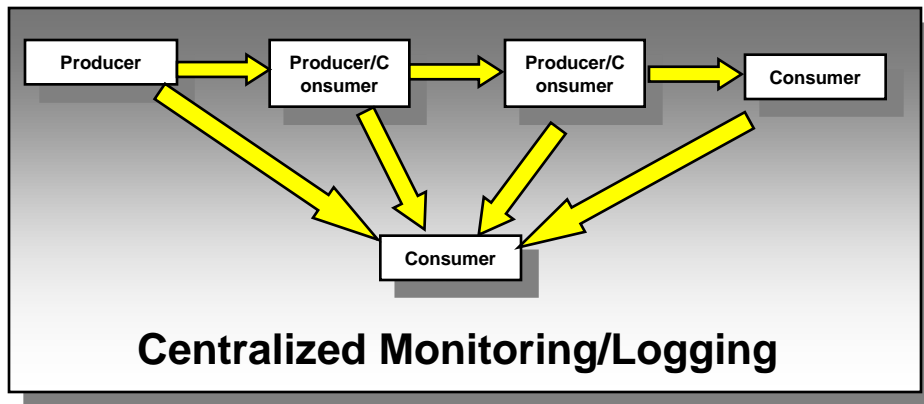
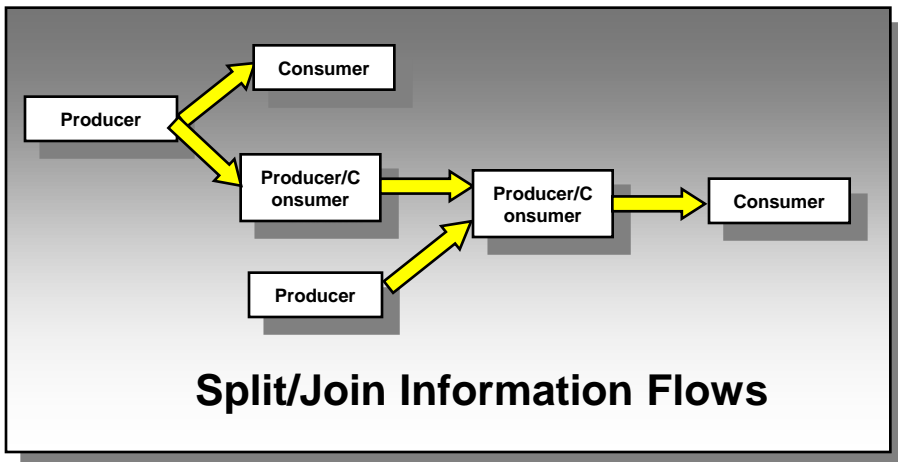
Details: www.biggun.army//...





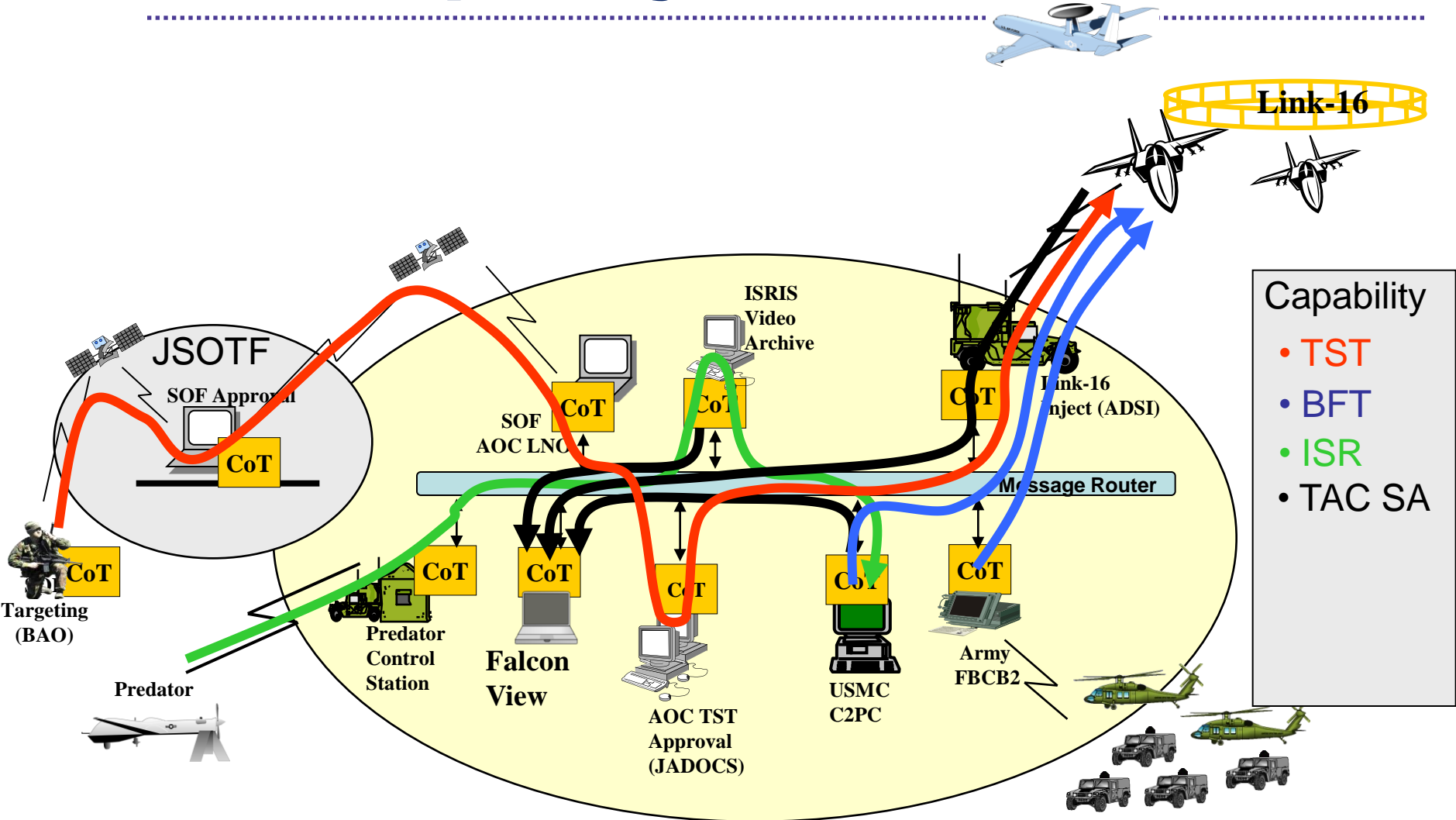
CoT Architectures Vary Widely

- CoT is designed to be *link agnostic*
- Interaction model push or pull (req/resp)
- Used: UDP, TCP, tactical radio, SOAP, etc





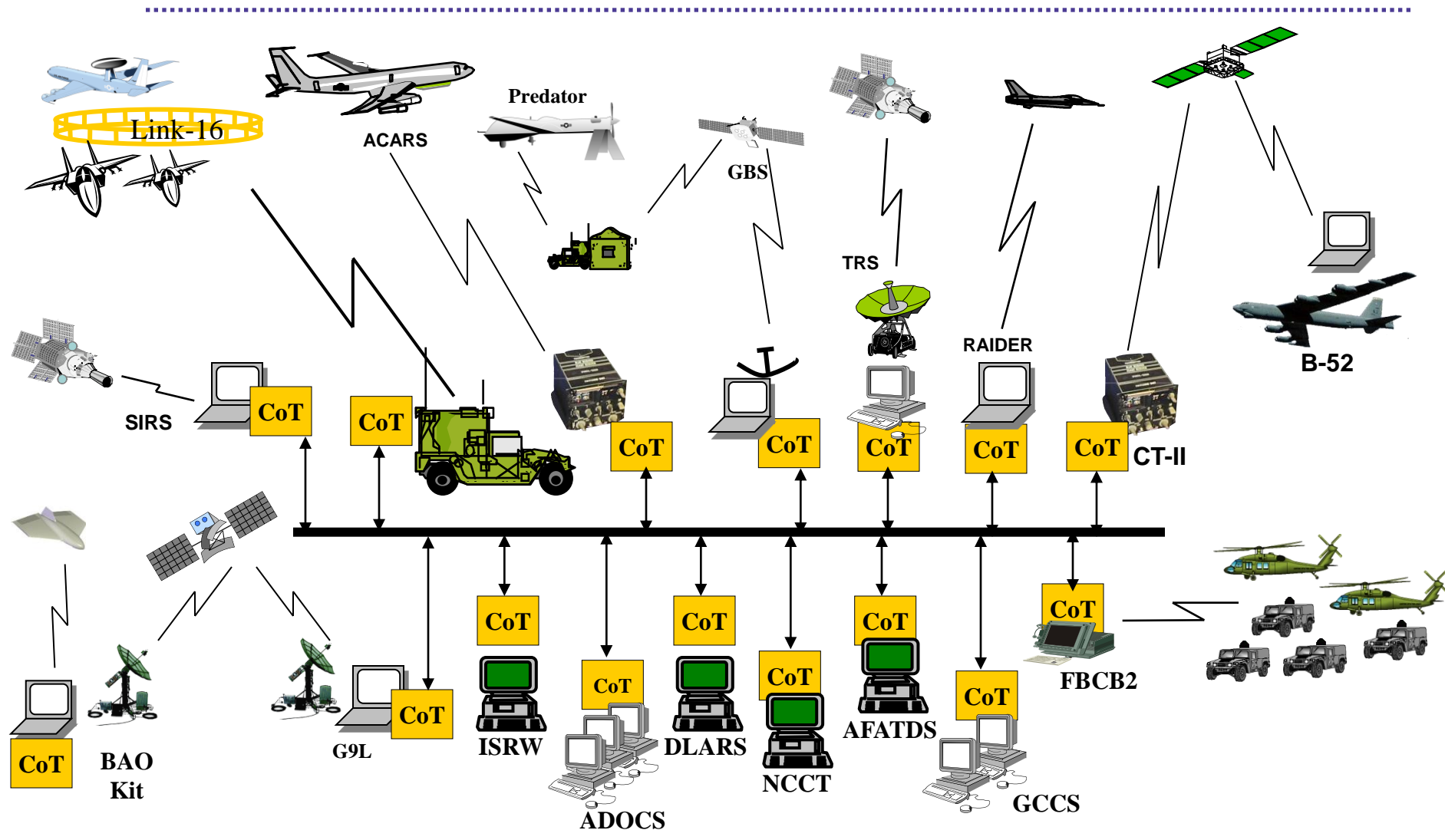
CoT Reduces Communication Complexity



Connects disparate systems to enable mission capability



130+ DoD Systems “speak” CoT...





CoT Components

■ An XML message schema

- *Basic (mandatory): “what, when, where”*
- *Extensible (optional): add subschema to add details*

■ A standard

- *Established as USAF standard by SECAF memo April 2007*
- *Incorporated in USAF (SAF/XC) Enterprise Architecture*
- *Registered by SAF/XC in DISROnline as a USAF Organizationally Unique Standard (OUS)*
- *Foundation for UCore data model*

■ A set of software plug-ins to enable systems to input and output CoT messages

■ A set of software translators to exchange messages with VMF and Link-16 networks

■ A CoT message router (software + computer) to facilitate publish/subscribe message routing

■ A simple developer’s tool kit



CoT Usage

- Employed heavily in AFSOC systems and UAS communities; used operationally 24x7 in Iraq and Afghanistan
- All Services, not just USAF
- Widely used in experimentation/demonstration venues
 - *JEFX, CWID, Empire Challenge, Bold Quest*
 - *Many others*

Examples

<u>ISR</u>	<u>UAV</u>	<u>Manpack</u>	<u>C2</u>
High Mobility FLIR	Video Scout	BAO Kit	AFATDS
Litening Pod	Raven and Wasp	Soldier-worn	Combat Track II
RAVE video exploitation	Air RECCE Low, MARSS	gunfire detection	FCS Test Bed
Constant Hawk		THLDS	JADSI

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CoT User Group Organizations

402 XMSG (AFMC)
642 AESS (AFMC)
645 AESS (AFMC)
653 ELSG (ESC)
653 ELSW/EID (ESC)
670th AESS (ASC)
720 STG/OSS
8 AF
812 AESG/SYCA (ITC)
HAF/A2U
HAF/A2UI
AAI Corporation
AFRL
AFSOC
AGIS, Inc.
Applied Research
ARINC
AVWatch
BBN
Boeing
BOSH Global Services
Critical Response
Deloitte
DHS
DRS-IAS
DSCI
ForceX

Foster-Miller
General Dynamics
Georgia Tech Electronic Systems
Laboratory
Harris
Insight Technology
Insitu
ITT Advanced Engineering and Sciences
Jackpine Technologies
JFCOM
Lockheed Martin
Johns Hopkins Advanced Physics Lab
Joint Interoperability Test Center
JFIIT
Kihomac
KC Regional Terrorism Early Warning
Group
L-3 Com
Lakota Technical Solutions
Missouri Civil Air Patrol
MIT Lincoln Labs
MITRE
Naval Postgraduate School
Naval Surface Warfare Center
NGA
Northrop Grumman
Oregon National Guard

Orion Networks
Proxy Aviation Systems
RAIDER TPG (US Navy)
Raytheon
Rockwell Collins
SET Corporation
Sierra Nevada Corporation
Smartronix
Symetrics
System Dynamics Int.
TAIS
Thales
Ticom Geomatics
Traverse Technologies
US Army
US Navy
USASOC-SOAR
USSOCOM
VIPMobile
Wintec Aeromaker, Inc.
WVHTC Foundation



Summary

- **Simple light weight core – Starts with most common data elements**
- **Sub-schema extension “Future-Proofs” standard**
- **Network-centric – Value grows as N^2 , not cost**
- **Readily Reconfigurable - Approach handles unforeseen needs**
- **Government developed, all material openly available to all with US DoD sponsorship**